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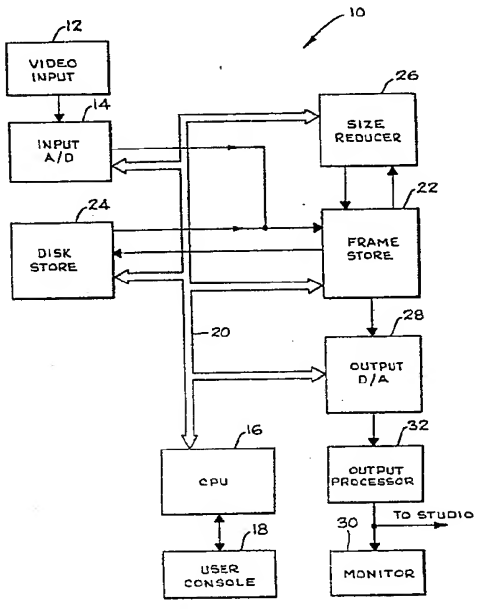
(54) Electronic still store with high speed sorting and method of operation.

(57) An eletronic still store system stores and selectively outputs video image data defining a plurality of signal frame still images. The simultenaous display of up to 16 or more reduced images for scanning or sorting by an operator is facilitated by generating a reduced sized copy of each newly received image frame and storing both together on a magnetic disk storage device (24). The reduced image can then be recalled directly for a multi-image scan or sort function in which a plurality of reduced size images are displayed simultaneously without the time delays associated with the retrieval and size reduction of the same number of full size images.



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"ELECTRONIC STILL STORE WITH HIGH SPEED SORTING AND METHOD OF OPERATION"

Background of the Invention

This invention relates to a digital electronic still store for broadcast television signals and more particularly to a still store providing a high speed multi-image scan or sort capability.

Digital electronic still store video display systems store a plurality of frames of video images on relatively low cost magnetic disk storage. Any selected one of the stored image frames may then be communicated to a frame store from which data defining the image is repetitively read out to generate a continuously displayed television image. The still store image can then be combined with a second image to create a combined video image. For example, it is common to insert a selected still store image depicting a news event in the upper left hand corner of a live studio image depicting a newscaster describing the news event.

The disk store is capable of storing a large library of single frame images and it is often desirable to generate a reduced size multiple image picture for editing or other purposes. For example, it might be desirable to create a special effect with multiple images or an editor may wish to view and compare several images at the same time for the purpose of selecting those images which will be used in a television broadcast. However, each of the several images which are to be simultaneously displayed must first be read from the disk store as full size images and then reduced for insertion into the multi-image display. This process takes 1/4 to 1/2 second for each image and results in a

delay of several seconds for the composite multi-image display. Such a time delay is at best disconcerting for a busy editor and precludes use of the editing features of the system during a real time broadcast.

U.S. Patent 4,172,264, "Control Arrangment for Video Synchronizers", to Taylor et al describes an arrangement in which joysticks may be used to selectively position video images on a television display. The system requires full sized images to be accessed and then reduced in size as described above.

U.S. Patent 4,302,776, "Digital Still Picture Storage System With Size Change Facility", to Taylor et al discloses a still store system in which multiple images may be accessed and reduced in size for simultaneous display as discussed above. The suggestion is made that an array of reduced size images be stored as a single image frame. This has the effect of eliminating the time required to reproduce the array but precludes the flexibility of choosing or repositioning any desired images when recalling the array. Furthermore, the aforementioned time delays are encountered when assembling the original multi-image display.

SUMMARY OF THE INVENTION

An electronic still store system in accordance with the invention rapidly generates and outputs for display to an operator a still image frame comprising a plurality of selectively positioned reduce size images which may be simultaneously viewed for scanning or editing purposes. The system includes an image store for storing therein a plurality of frames of video images with both a full spatial resolution copy for full size video output and a reduced spatial

resolution copy for reduced size video output of each image being stored, and a frame store which is operable in a first mode to receive from the image store, store and repetitively generate a full spatial resolution output image frame. The frame store is operable in a second mode to receive from the image store and store a plurality of reduced spatial resolution image frames. The frame store is further operable in the second mode to repetitively generate an output image frame having an image from each of the plurality of reduced spatial resolution image frames selectively located at a different position within the output image frame.

The system may further include an image size reducer coupled to produce a reduced spatial resolution image in response to a full resolution image stored by the frame store, a video input, an analog-to-digital converter coupling the video input to the frame store, a monitor for viewing output video images and an output digital-to-analog converter coupled to convert the output video images from a digital form to an analog form for use by the monitor. A central processing unit is connected to receive user commands through a user console and to control the other devices of the system in response thereto.

The image store employed herein may be a general purpose magnetic disk storage system as is currently used in general purpose digital computer systems.

In operation the system may rapidly assemble an array of reduced size images for output as a single image frame. A system operator may view the reduced size images simultaneously for rapid scanning of some or all of the stored images within the image store, which is preferably a magnetic disk. Because the images are read from the image

store in reduced size and spatial resolution, the output image formation time is approximately the 1/4 to 1/2 second required to transfer a single full size image instead of the several seconds required for the transfer of, for example, sixteen full size images prior to resolution reduction and storage as a reduced size image.

Using this system an operator may rapidly scan many still frame images which are stored by the image store or may compile lists of randomly selected image frames for simultaneous viewing as an array of reduced size images. Because of the rapid response rate the system becomes feasible for development and outputting of data frames containing multiple reduced size images on demand during a television broadcast.

BRIEF DESCRIPTION OF THE DRAWING

A better understanding of the invention may be had from a consideration of the following detailed description taken in conjunction with the accompanying drawing which FIGURE 1 is a block diagram representation of an electronic still store system in accordance with the invention.

DETAILED DESCRIPTION

Referring now to FIGURE 1, a digital electronic still store system 10 for rapidly assembling as a single image frame an array of reduced size images is shown as including a video input circuit 12. The video input circuit 12 may be another electronic still store system, a TV camera, or some other source of video data from which one or more frames of a video image may be captured. In a

referred embodiment of the electronic still store system 10, the video signal is processed in component form. A method and apparatus for producing the component information which may be employed is more fully disclosed in our European Patent Application No. filed 7th March 1984, entitled "Apparatus and method for chroma separation".

Therefore, the video input 12 will include appropriate video signal decoding means to process video data received from sources that provide the data in an encoded form.

An input analog-to-digital (A-D) converter 14 is coupled to receive an input video signal provided by the video input circuit 12, which typically includes video signal processing circuitry that prepares the signal for conversion by the A-D converter 14. The A-D converter 14 converts the input video signal to a digital form which is suitable for handling and processing by digital circuitry, and in particular the converter 14 converts the video signal received from the video input into a digital sampled data form in which each pixel of video data is represented by three eight bit data bytes luminance, red chrominance and blue chrominance components. Conventionally, the chrominance data has half the spatial resolution of the luminance data in the horizontal dimension so that data is produced in a repetitive 4 byte luminance/chrominance component sequence of L1, CR1, CB1, L2---L3, CR3, CB3, L4 and so fourth. The single byte representation afford a high dynamic resolution of 256 distinguishable states for each color component. For adequate dynamic resolution, each video component at a sampled data point is preferably defined by at least 6 binary bits providing 64 distinguishable intensities. A central processing unit (CPU) 16 formed from a Z80 microprocessor is connected to receive operator commands from a user console 18. CPU 16 is connected for bidirection communication of commands and other data over a system bus 20. The system bus 20 is connected to input A-D 14 as well as other major components

of the still store system 10 to carry the address, mode select and status information required to control the operation of the still store system 10.

A frame store 22 is coupled to receive mode control information from CPU 16 over system bus 20 and to receive video data representing a frame of a video image from either input A-D 14 or a multiple frame image store implemented as a magnetic disk drive store 24. Frame store 22 is a random access store that is capable of storing more data than is required for a single video image frame.

The storage capacity provided by presently 64K memory chips enables storing up to 750 lines of video data. In any event, out of a 525 line NTSC frame of data only about 484 lines represent video data. Because of the two dimensional nature of a video image an image defined by video data having a given fraction (such as one quarter) the spatial resolution of a full size image requires the square of that fraction (i.e. one sixteenth) of the storage capacity of a full size image of full spatial resolution. A quarter resolution image thus requires the equivalent storage of 30 lines of a full resolution image. In any event the frame store 22 either contains initially or is expanded to contain storage of video data representing a full resolution, full size image and a reduced resolution copy, in this embodiment a quarter-resolution copy.

A size reducer 26 is connected to be controlled by data from CPU 16 received over the system bus 20. Size reducer 26 is operable to receive video data from frame store 22 to convert the video data to a quarter spatial resolution copy thereof, and communicate the quarter copy back to frame store 22 for storage therein. In a fashion, when video data received from disk store 24 does not contain a corresponding quarter spatial resolution

copy, size reducer 26 may be employed to generate a quarter spatial resolution copy for subsequent transfer to either the frame store 22 or disk store 24. Hence, any time frame store 22 receives a video image frame that does not have a corresponding quarter resolution copy the size reducer 26 may be used to make such a copy.

As a new frame of video data is transferred from frame store 22 to disk store 24 for more permanent storage, both the full resolution and the quarter resolution copy are transferred. Since the quarter resolution copy by only one-sixteenth the data of a full resolution copy, the communication and storage of the quarter resolution copy imposes only a small burden on both system operating time and extra storage space requirement within disk store 24. It should be noted that disk store 24 is a general purpose magnetic disk storage device as is commonly used in connection with general purpose digital computing systems.

During operation of the system frame store 22 repetitively accesses stored video data to generate a continous stream of output video data frames representing the stored image. An output digital-to-analog converter 28 receives this digital output data and converts it to an analog video signal from which is subsequently supplied to output processor 32. Output processor 32 may be an ordinary video signal output processor to form a television signal in a standard format, which can be used to drive a monitor 30 for viewing of the output video image by a system monitor. The analog video signal may also be communicated to studio equipment for further use, broadcasting or storage.

When operating in a first, normal broadcast mode, frame store 22 receives a full resolution frame of video data from disk store 24 and outputs a continuous

television image in digital data form in response thereto.

In a second, editing or browsing mode, CPU 16 commands disk store 24 to output reduced resolution image data which is selectively positioned in frame store 22 for viewing in one of 16 reduced size image positions in a 4 x 4 array within a normal full size image. Under operator control, the 16 viewable images may be take sequentially from disk store 24 starting with a selected image frame. This mode is useful when scanning all of the images stored by disk store 24. Alternatively, the 16 images may be taken randomly from a list of stored images developed by the operator. This mode is especially useful when it is desired to compare certain images.

The 16 image assembly time is greatly reduced because only an amount of data equivalent to one full size, full spatial resolution, image need be transferred from disk store 24 to define all 16 images. This is only one-sixteenth of the time that would normally be required.

CLAIMS:

1. An electronic still store system comprising:

an image store (24) arranged for retrievably storing therein a plurality of frames of video images with both a full spatial resolution copy and a reduced spatial resolution copy of each image being stored; and

a frame store (22) which is operable in a first mode to receive from the image store and repetitively generate a full spatial resolution output image frame and operable in a second mode to receive from the image store and store a plurality of reduced spatial resolution image frames, the frame store being further operable in the second mode to repetitively generate an output image frame having an image from each of the plurality of reduced spatial resolution image frames selectively located at a different position within the output image frame.

2. A system according to claim 1, further comprising a size reducer (26) coupled to receive from the frame store a full spatial resolution image frame and in response thereto to return to the frame store a reduced spatial resolution image frame and wherein the frame store is operable to receive and store the reduced spatial resolution image frame while continuing to store the full spatial resolution image frame.

3. A system according to claim 2, wherein the reduced spatial resolution image frames each have a spatial resolution of one-fourth the spatial resolution of the full spatial resolution image frames in each dimension of an image.

4. A system according to any foregoing claim, wherein a central processing unit (16) is coupled to select in response to control by an operator which image copies are retrieved from the frame store and the location within the frame store at which each image copy is stored.

5. A system according to any of claims 1 to 3, wherein a central processing unit (16) is coupled to select in response to control by an operator to command the retrieval of a plurality of reduced spatial resolution images from the image store and the placement of the retrieved images as reduced size images within an output image frame generated by the frame store.

6. A system according to any foregoing claim, further comprising an output digital-to-analog converter (28) coupled to receive output image frames from the frame store and in response thereto to generate an analog video signal representing the received output image frames.

7. A system according to any foregoing claim, further comprising means (12) generating an analog video signal representing a sequence of video image frames and an analog-to-digital converter (14) arranged for converting the analog video signal to a digital form in which digital data representing a video image frame can be received and stored by the frame store.

8. A system according to claims 5 to 7, further comprising a user console (18) coupled to receive operator commands and output received operator commands to the central processing unit, the central being a processing unit coupled to receive the operator commands

output by the operator console and in response thereto to generate control signals for controlling system devices including the input analog-to-digital converter, the image store, the frame store, the size reducer, and the output digital-to-analog converter, and a system bus (20) coupling the control signals to the controlled system devices.

9. An electronic still store system comprising:

a size reducer which receives normal image data representing a normal video image and converts the normal image data to reduced image data;

a frame store coupled to receive and store at first selected locations therein normal image data representing a video image, the frame store being coupled to communicate full image data to the size reducer, to receive back from the size reducer reduced image data, to store the reduced image data received from the size reducer in second selected locations in the frame store, and to repetitively output the full image data, the frame store being further operable to receive and store in the first selected locations image data representing a plurality of reduced images to form a single image comprised of the plurality of reduced size images; and

an image store coupled to receive from the frame store, to store and to retrieve image data representing a plurality of normal images and image data representing a reduced image of each of the normal images.

10. A video still store system comprising:

a size reducer coupled to receive full image data representing a frame of a full image and produce reduced image data representing a frame of a corresponding reduced image in response thereto;

an image store for storing full image data representing a plurality of frames of full images and reduced image data representing a plurality of reduced images, each corresponding to one of the full images; and

a frame store operably coupled to selectively receive from either an external source or the image store and store a frame of full image data representing a full image, to repetitively retrieve and output a stored frame of the full image data, to retrieve and communicate to the size reducer the stored frame of full image data, to receive from the size reducer and store a frame of reduced image data representing a reduced image corresponding to the stored full image, to selectively retrieve and output to the image store both the frame of full image data and the frame of reduced image data, and to receive from the image store and store a plurality of frames of reduced image data with the reduced image data for each different reduced image being stored in a different location within the frame store such that when the frame store operates to repetitively retrieve and output a stored frame of full image data, the reduced images represented by the reduced image data are disposed at different selected locations within an image represented by the repetitively retrieved and output frame of full image data.

11. A method of operating a video still store system having an image store (24) and a frame store (22) coupled for bidirectional communication of video data with the image store comprising the steps of:

writing into the image store video data representing a plurality of full resolution images;

writing into the image store for each said full

resolution image video data representing a reduced resolution copy thereof; and

transferring from the image store to the frame store, for assembly in the frame store as a single composite image, data representing a reduced resolution copy of each of a selected plurality of images.

12. A method according to claim 11, wherein each reduced resolution copy has a spatial resolution of one-fourth the spatial resolution of the corresponding full resolution image in each of two display dimensions.

13. A method according to claim 11 or claim 12 in which the transferred video data is stored in the frame store in locations selected to produce a composite image having each of the images represented by the transferred video data positioned at a selected different position within the composite image.

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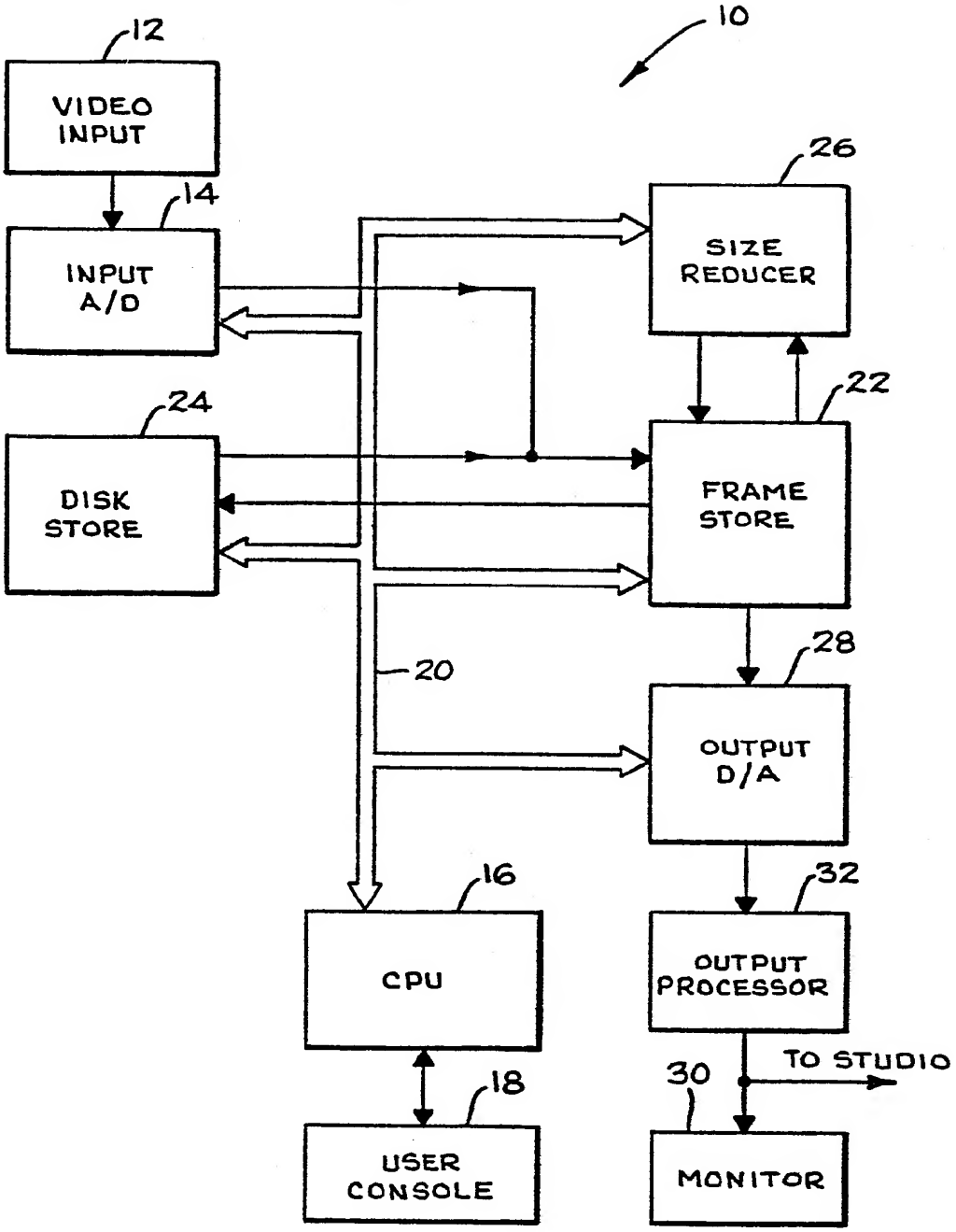
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VIDEO INPUT
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FRAME STORE
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USER CONSOLE
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OUTPUT PROCESSOR
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TO STUDIO
MONITOR